

DEBATE

HIV, ABC and DHS: age at first sex in Uganda

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Debate

Although the DHSs for Uganda provide evidence of an upward trend in age at first sex between 1995 and 2000, they also provide evidence of bias in either response or sample membership sufficient to offset all evidence of trend for men and much of the evidence for women. These data therefore do not provide evidence that Ugandans are responding to the HIV epidemic by prolonging abstinence.

The Abstain-Be-Faithful-Condoms (ABC) approach to prevent HIV emphasises the delaying of age at first sex. To investigate adoption of the ABC approach, Zaba *et al*¹ estimated the median age at first sex from the DHSs. They inferred that this median has increased. Gersovitz,² however, showed that the bias in response could account for the deferral of first sex in several DHSs. This paper scrutinises two DHSs for Uganda, an oft-cited example of the success of ABC,³ and argues against the findings of Zaba *et al*.

METHODS AND DATA

With two surveys for one country at different times and questions about age at first sex, one can estimate trends in age at first sex and bias in respondents' answers over time. The trend can be calculated as the difference in proportions in two surveys of men or women whose age falls in a fixed interval, and who report being virgins before a particular age. To exclude people with the same year of birth (same cohort) from both proportions and to avoid attenuating any trend, the age range should not exceed the difference in time between surveys.

As the interest is about populations and different respondents were selected with different probabilities, proportions and significance tests should use sample weights. As sampling used clusters, significance tests should adjust for correlation among the answers of respondents from the same cluster (SVYMEAN command of the STATA program).

As the surveys are not true panels, the same people probably do not appear in both surveys, and in particular cohort restrictions in calculating trends mean that the same people cannot be in both proportions. Nonetheless, positive correlations may exist in different respondents' answers between surveys, because the surveys used some of the same clusters, and common influences on everyone in a cluster may persist. Tests, however, must assume that respondents were chosen independently because available information does not designate the common clusters. Positive correlations between surveys in different respondents' answers mean that tests understate the significance of differences in proportions.

Two surveys allow a check for bias in answers at different times about when people first had sex.

Despite the surveys not being panels, people in a cohort in the first survey should statistically represent people in the same cohort in the second survey, absent selectivity bias from differential mortality or international migration, which, Gersovitz² argues, is unimportant in the Ugandan DHSs.

One way of checking for bias is to calculate for each survey the proportions of men or women in a group of cohorts who were virgins before a threshold age. All the cohorts should be common to both surveys, and therefore include only cohorts who were at least of the threshold age in the first survey and who are young enough to satisfy the age restrictions for participation in both surveys. The proportions should be the same, regardless of the survey. Tests of the difference between proportions therefore test for bias in the answers of the same cohorts across surveys. Calculations should use sample weights and significance tests corrected for cluster structure. As bias in answers of the youngest cohorts might be most relevant to the reliability of a trend based on answers of the youngest cohorts, the bias test should be recalculated using only answers of the youngest cohorts in the first survey and of the same cohorts in the later survey.

The Ugandan DHSs of 1995 and 2000 are nationally representative, except for limited areas omitted for fear of violence.⁴⁻⁵ They used weights and clusters in sampling, and information on both are available. Not everyone who was contacted participated, and not all participants answered about age at first sex, hence it is important to investigate possible sample-membership bias.

RESULTS

At the time of the surveys, the lifetime experiences of the cohorts were incomplete. Comparisons therefore depend on truncated experience, especially for younger cohorts. Columns 1–3 of tables 1 and 2 report the proportions of men and women in 3-year age groups in the surveys who say that they were virgins before 16 years of age. Zaba *et al*¹ used the median age at first sex as an alternative truncation. A proportion is simpler to calculate and sidesteps knowing whether the median is within the age range of the data.

Table 2 reports an increase between surveys in the proportions of women aged 16–18 years who report being virgins before 16 years of age at the time of the survey. For men, the proportions are essentially the same. People aged 16–20 years at the time of each survey form the largest group that could not answer this question in both surveys given 5 years between surveys. The "Trend" row in table 1 presents the differences in these proportions from the two surveys and *t* statistics. This proportion increased

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Table 1 Ugandan men

	Fraction with no sex before 16 years of age			Fraction with no sex before 19 years of age			Fraction with secondary education			Fraction of participants who respond about first sex			Proportion of participants by age	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Age (years)	1995*	Check 2000*	2000†	1995*	Check 2000*	2000†	1995*	Check 2000*	2000†	1995*	Check 2000*	2000†	1995*	2000†
16–18	0.733	—	0.727	—	—	—	—	—	—	0.989	—	0.997	0.140	0.162
19–21	0.654	—	0.752	0.271	—	0.380	0.342	—	0.340	0.989	—	0.950	0.122	0.112
22–24	0.672	0.696	0.845	0.268	—	0.393	0.293	—	0.328	1.000	0.990	0.804	0.115	0.108
25–27	0.635	0.671	0.724	0.302	0.262	0.351	0.235	0.307	0.369	1.000	0.988	0.755	0.122	0.108
28–30	0.672	0.639	0.732	0.314	0.281	0.314	0.283	0.247	0.263	1.000	1.000	0.687	0.109	0.100
31–33	0.634	0.679	0.707	0.233	0.313	0.379	0.345	0.269	0.323	1.000	1.000	0.824	0.085	0.098
34–36	0.701	0.618	0.781	0.234	0.293	0.397	0.230	0.322	0.271	0.996	1.000	0.891	0.084	0.093
37–39	0.647	0.673	0.786	0.216	0.204	0.388	0.235	0.312	0.239	1.000	1.000	0.901	0.075	0.071
40–42	0.713	0.696	0.817	0.298	0.234	0.377	0.169	0.246	0.255	0.995	0.996	0.853	0.061	0.067
43–45	0.617	0.687	0.871	0.288	0.292	0.385	0.175	0.174	0.327	1.000	1.000	0.951	0.048	0.041
46–48	0.625	0.654	0.841	0.238	0.255	0.468	0.163	0.210	0.197	0.998	0.993	1.000	0.039	0.041
Trend‡	391/435	0.042	1.11	383/301	0.093	2.01								
Bias-all‡	1833/1202	0.113	5.37	1593/1052	0.111	3.85	1448/1100	0.038	1.47	1842/1437	–0.153	13.29		
Bias-5‡	391/272	0.079	2.12	383/259	0.084	1.77								

*From the 1995 DHS for Uganda.

†From the 2000 DHS for Uganda.

‡The number of respondents in the analysis from 1995 and 2000, the difference in the proportions between the 2000 and the 1995 surveys (in the Check column), and the associated t statistic (in the adjacent cell to the right). For more details see text. All proportions are calculated with population weights, and all significance tests are corrected for population weights and cluster membership.

for both men and women, but the difference was statistically significant only for women.

One important aspect of sex before 16 years of age is that it refers to a fixed age, and is unchanged as someone ages. For such variables, two types of analysis are possible. Firstly, with only one survey, there is information on trends from answers of people of different ages. Secondly, more than one survey permits a check for bias.

The retrospective information spans more than the 5 years between surveys, being >30 years in tables 1 and 2 for first sex before 16 years of age. The two youngest (grouped) cohorts span 6 years. Looking down the columns for 2000, the two youngest cohorts of women but not of men report an increased proportion of virgins before 16 years of age.

To check for bias, column 2 of tables 1 and 2 present responses in 1995 from the same cohort (rather than people of the same age when they responded) as the people of the 2000 survey in column 3. All these people respond about behaviour before 1995. For instance, people aged 17–19 years in 1995 are 22–24 years old in 2000, and their responses in 1995 in the “Check 2000” column are compared with those of people aged 22–24 years in 2000. In the absence of bias, adjacent cells of the two columns should be equal, excluding sampling error because the surveys are not panels and therefore would not have identical respondents.

There are large biases. For men, the later answers of the same cohort indicate a much larger deferral of age at first sex. These findings undermine confidence in the observed positive trend in age at first sex from direct comparison across the surveys for the youngest cohorts. When the proportions of men and women saying that they

were virgins before 16 years of age show that every cell in 2000 exceeds the corresponding “Check 2000” cell from 1995, it raises concerns that the cells for people aged 16–18 years in 2000 may similarly embody upward bias special to the 2000 survey or when it was administered.

To test for statistical significance of these biases, I looked at cohorts who were ≥16 years of age in 1995 but young enough in 1995 to be in the 2000 survey. In 1995, male and female cohorts were 16–49 years and 16–44 years of age, respectively. Bias exists if the proportions of people in these cohorts in each survey who reported not having had sex before 16 years of age are significantly different; otherwise, what people born in the same year say about whether their age at first sex was before 16 years of age does not (statistically) depend on the year of the survey they answer. The differences between the proportions from 2000 and 1995, and associated t statistics appear in the “Bias-all” rows of tables 1 and 2 (columns 2 and 3). Both men and women exhibit significant positive bias, overstating deferral of age at first sex in 2000 relative to 1995.

As bias in the answers of the youngest cohorts is most relevant to the reliability of a trend calculated from the answers of the young, I recalculated the proportions who reported not having had sex before 16 years of age for the five youngest cohorts in 1995 (people aged 16–20 years) and for people in the same cohorts in 2000. The differences between the proportions from 2000 and 1995 and associated t statistics appear in the bias-5, rows of tables 1 and 2 (columns 2 and 3). Clear significant positive bias is observed only for men for this 5-year group. Although the statistical significance of bias for women in these five cohorts is marginal, combined with the results from the bias-all tests, there is overall evidence for bias for women as well. The

Table 2 Ugandan women*

Age (years)	Fraction with no sex before 16 years of age			Fraction with no sex before 19 years of age			Fraction with secondary education			Fraction of participants who respond about first sex			Proportion of participants by age	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1995	Check 2000	2000	1995	Check 2000	2000	1995	Check 2000	2000	1995	Check 2000	2000	1995	2000
16–18	0.570	–	0.697	–	–	–	–	–	–	0.982	–	0.990	0.151	0.149
19–21	0.537	–	0.630	0.134	–	0.173	0.167	–	0.239	0.971	–	0.968	0.141	0.138
22–24	0.556	0.548	0.606	0.149	–	0.149	0.155	–	0.222	0.935	0.977	0.950	0.135	0.122
25–27	0.501	0.556	0.608	0.121	0.142	0.182	0.163	0.168	0.214	0.953	0.956	0.931	0.121	0.124
28–30	0.431	0.521	0.570	0.120	0.130	0.158	0.129	0.142	0.158	0.936	0.938	0.937	0.112	0.117
31–33	0.468	0.479	0.517	0.097	0.110	0.116	0.125	0.160	0.148	0.911	0.957	0.918	0.085	0.072
34–36	0.458	0.444	0.597	0.164	0.135	0.171	0.102	0.134	0.110	0.920	0.919	0.917	0.078	0.077
37–39	0.412	0.459	0.563	0.124	0.104	0.165	0.100	0.125	0.124	0.915	0.898	0.931	0.055	0.064
40–42	0.425	0.429	0.510	0.130	0.149	0.134	0.073	0.093	0.123	0.929	0.929	0.932	0.054	0.061
43–45	0.479	0.457	0.546	0.178	0.149	0.150	0.062	0.090	0.092	0.917	0.931	0.899	0.039	0.042
46–48	0.415	0.402	0.586	0.120	0.102	0.156	0.038	0.073	0.074	0.930	0.939	0.934	0.031	0.034
Trend	1690/ 1730	0.120	5.24	1560/ 1520	0.017	1.01								
Bias-all	6091/ 4828	0.073	4.27	5091/ 3984	0.030	2.52	4704/ 3672	0.008	0.54	6422/ 5177	–0.015	2.64		
Bias-5	1690/ 1431	0.041	1.65	1560/ 1340	0.034	2.03								

*Table footnotes of table 1.

use of responses by older cohorts, and the attendant uniform evidence of bias and its statistical significance is the main difference between my results and those of Zaba *et al.*,¹ who use only respondents aged 15–24 years. Sample sizes are small when respondents are restricted to younger cohorts, especially for men because the DHSs sampled fewer men than women (table 3, row 2). It is also impossible to correct for positive correlation caused by the surveys sharing some clusters, hence significance of differences is underestimated.

To provide additional evidence on both trend and bias, columns 4–6 of tables 1 and 2 summarise answers about sex before 19 years of age. For men, there is a significant upward trend in age at first sex between the two surveys, but not for women. The bias-all calculation produces significant bias for men and women. The “bias-5” calculation for the five youngest cohorts that can be compared produces significant bias for women but not for men, reversing the finding for first sex before 16 years of age.

In combination, the calculations of trend and bias produce no trend free of bias. For men, there is a significant trend in sex before 19 years of age, but there is also significant positive bias for sex before both 16 and 19 years of age. The positive bias (bias-all of table 1) exceeds the positive trend, so the trend can be discounted. Women, like men, exhibit significant evidence of positive bias (and of trend for sex before 16 years of age that does exceed the corresponding estimate of bias).

Efforts in Uganda to promote what is thought to be cautious sexual behaviour may have largely resulted in both men and women claiming to have adopted such behaviour rather than actually having done so. There are alternative interpretations: older cohorts realising that 16–18-year olds in 2000 have actually delayed first sex may wish to report that they behaved similarly, leaving these

16–18-year olds as the only accurate respondents. Perhaps Ugandans understated their caution in 1995, and decided to answer accurately in 2000.

Yet another source of bias could be incompatibilities in the implementation of surveys. Violence precluded implementation in some areas, which differed between surveys, but the differences do not seem large. But other issues of sample membership could lead to bias, providing an alternative hypothesis to inaccurate answers by survey respondents.

Table 3 provides more information on the reliability and comparability of the surveys. Rows 1 and 2 show that not everyone contacted by the survey teams participated. Participation rates were 85–95%, lower for men than for women. Furthermore, not all participants have responses about when they first had sex. If not, answers were usually coded as inconsistent. In 2000, >10% of male participants responded inconsistently.

Were they to have answered, non-participants and non-respondents might have answered systematically differently than people with recorded responses. There are enough non-participants and

Table 3 Characteristics of the sample

	Men		Women	
	1995	2000	1995	2000
1 Total contacted	2224	2306	7377	7717
2 Total in sample (participants)	1996	1962	7070	7246
3 Total answering about age at first sex (respondents)	1987	1718	6711	6874
4 Total answering about secondary education	1996	1962	7070	7245

All entries were based on the calculations from the computer files for the surveys except for information on the total contacted, which are reported in the published reports on the surveys.^{4,5}

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non-respondents relative to the bias to account for it all. Hence, the observed bias does not necessarily mean that the people with answers in tables 1 and 2 did not answer truthfully (response bias) rather than that people were systematically missing from the sample (sample-membership bias). But if such people are missing, trends would have to be recalculated to include them, and the inclusion of such people would undermine the existence of a trend. One qualification is that the youngest cohorts have especially high response rates about age at first sex, particularly men in 2000 for whom response rates are generally low (tables 1 and 2, columns 10 and 12), limiting the effect of such recalculations. Non-response by age is mostly recorded because almost everyone answers about age, but non-participation by age is unknown, hence information on non-response by age only hints that sample-membership bias may not undermine the calculated trends if indeed it, rather than response bias, is the source of the apparent bias.

Zaba *et al*¹ adjusted the median age at first sex by the education and location of respondents. Their motivation is bias in answers of people aged 15–24 years, similar to that in tables 1 and 2. They hope that correcting for two variables that may be correlated with problems of sample representativeness can allow unbiased inferences about trends in age at first sex. But, they do not present the median age at first sex for the same cohorts in different surveys corrected for education or location, hence it is unclear whether these corrections diminished the bias. Furthermore, adding parameters with small subsamples consequent on considering only people aged 15–24 years may lose the statistical power to identify bias in a way similar to the contrast between the bias-all and bias-5 calculations. Finally, as these authors remark, the secondary education of people as young as 15 years can change over time, especially in Africa with older students than elsewhere. People can change their residence anytime and I therefore do not discuss location further. Changes between surveys in the education or location of cohorts, especially young ones, need not imply problems with implementation of the surveys.

The comparison of proportions of a cohort that has some or completed years of secondary education and is old enough that more secondary education is unlikely, provides another test of intersurvey consistency. Columns 7–9 of tables 1 and 2 present these proportions for 3-year cohorts and bias-all checks for cohorts in both surveys that were >20 years of age in 1995. There is no bias in the reporting of education, and therefore no evidence that either survey disproportionately sampled people with more secondary education. Perhaps people find questions about education less disconcerting than those about age at first sex, and answered accurately. Almost everyone answered

about education, hence non-response is not a problem (table 3). I repeated the bias test in reporting secondary education for only those participants answering about age at first sex. Any bias would imply that one of the samples has respondents to the question on age at first sex with disproportionately more secondary education. There was no evidence of such bias. A bias-all calculation for age at first sex, if before 19 years of age, for respondents with some or complete secondary education produced results similar to that for people without such education, hence bias does not depend on education.

Finally, columns 13 and 14 of tables 1 and 2 provide information that the age distributions of participants in the two surveys are similar.

Key messages

A comparison of two Demographic and Health Surveys (DHSs) in Uganda shows that there is bias in the reporting of age at first sex by the same cohorts at different times of a magnitude that could be comparable with the trends in age at first sex. It is not possible therefore to assert that one can reliably establish that there has been an increase in deferral of age at first sex. This bias could either be because respondents misrepresent their behaviour or because there is systematic non-participation or non-response, and there is not enough information in the surveys to distinguish these hypotheses.

CONCLUSIONS

The surveys in Uganda exhibit several anomalies directly relevant to inferences about age at first sex. They are sufficiently large to call into question a conclusion that age at first sex is increasing consequent on ABC interventions.

Competing interests: None.

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